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ORIGINAL ARTICLE / ÖZGÜN MAKALE

EXPLORATION OF HALLUCINOGENIC COMPOUNDS IN *PEGANUM HARMALA*, A POPULAR INCENSE IN FOLK CULTURE, COUPLED WITH ANATOMICAL ANALYSIS

HALK KÜLTÜRÜNDE POPÜLER BİR TÜTSÜ OLAN PEGANUM HARMALA'DAKİ HALÜSINOJENİK BİLEŞİKLERİN ANATOMİK ANALİZLERLE BERABER ARAŞTIRILMASI

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ABSTRACT

Objective: *Peganum harmala L., commonly known as "harmala," is extensively used as an herbal incense product today and is renowned for its reported calming effects on humans. This study aims to perform a structural characterization of incense, with a particular focus on its fruit and seed components, by analyzing both the combustion process and dissolving the resulting smoke in an appropriate solvent. Additionally, we aim to contribute to the literature by investigating the presence of hallucinogenic compounds in this incense. Simultaneously, anatomical features of pedicels, petals, sepals, stamens, and pistils of P. harmala were examined through manual sectioning.*
Material and Method: *Smoke from incense was dissolved using n-hexane and dichloromethane solvents. Chemical analysis of seeds and fruits was conducted using GC-MS at the Erzurum Regional Criminal Police Laboratory Directorate. Anatomical characterization involved manual sectioning of pedicels, petals, sepals, and pistils, followed by examination under a microscope.*
Result and Discussion: *Upon analysis of samples extracted from dichloromethane and n-hexane solvents, the presence of harmine-a compound exhibiting hallucinogenic properties-has been identified. Harmine is known to impact human perception, cognition, and emotions by influencing central nervous system. The anatomical analysis revealed the presence of glandular trichomes on the pedicel, and sepal. Chemical compounds in smoke of P. harmala seeds and fruits, including hallucinogenic compound harmine, were identified through GC-MS analysis.*
Keywords: *Anatomy, GC-MS, harmine, incense, Peganum harmala*

ÖZ

Amaç: *Genellikle "harmala" olarak bilinen Peganum harmala, günümüzde insanlar üzerinde bildirilen sakinleştirici etkileriyle tanınan bitkisel bir tütsü ürünü olarak yaygın bir şekilde kullanılmaktadır. Bu çalışma, tütsünün meyve ve tohum bileşenlerine odaklanarak, tütsünün yakılması ve dumanının uygun bir çözücü ile çözülmesi yoluyla yapısal karakterizasyonunu*

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gerçekleştirmeyi hedeflemektedir. Ayrıca, bu tütsüde halüsinojenik bileşiklerin varlığını araştırarak literatüre katkıda bulunmayı hedeflemektedir. Eş zamanlı olarak, P. harmala'nın pedisel, petal, sepal, stamen ve pistillerinin anatomik özellikleri manuel kesit alma yoluyla incelenmiştir.
Gereç ve Yöntem: *Tütsü dumanı n-hekzan ve diklorometan çözücüleri kullanılarak çözülmüştür. Tohum ve meyvelerin kimyasal analizi Erzurum Bölge Kriminal Polis Laboratuvarı Müdürlüğü'nde GC-MS kullanılarak yapılmıştır. Anatomik karakterizasyon, pedisel, petal, sepal, stamen ve pistillerin elle kesitlerinin alınmasını takiben mikroskop altında incelenmesiyle gerçekleştirildi.*
Sonuç ve Tartışma: *Diklorometan ve n-hekzan çözücülerinden ekstre edilen örneklerin analizi sonucunda, halüsinojenik özellikler gösteren bir bileşik olan harminin varlığı tespit edilmiştir. Harminin merkezi sinir sistemini etkileyerek insan algısını, bilişini ve duygularını etkilediği bilinmektedir. Anatomik analiz sonucunda, pedisel ve sepalde salgı tüylerinin olduğu görülmüştür. P. harmala tohum ve meyvelerinin dumanında bulunan ve halüsinojenik bileşik harmini de içeren kimyasal bileşikler GK/ KS analizi ile tanımlanmıştır.*
Anahtar Kelimeler: *Anatomi, GK/ KS, harmin, Peganum harmala, tütsü*

INTRODUCTION

Throughout history, individuals have harbored fears of malevolent forces such as the evil eye, evil spirits, and demons, among others. In seeking protection from these afflictions and coping with various calamities, people turned to natural remedies. Ancient civilizations extensively relied on rituals, often incorporating widespread use of incense, as offerings and sacrifices to appease the gods and mitigate adversities [1]. Incense served various purposes beyond religious rites and masked unpleasant odors, notably during funerals, and provided protection against malevolent forces like evil spirits. As civilizations feared the evil eye and magic's potential to cause harm, incense became a sought-after method of protection, highlighting its cultural significance [2].

For generations, Anatolian people have relied on prayer and protective amulets to ward off evil eyes. These include items like garlic and eggshells. Additionally, burning incense made from plants like black cumin and cloves was believed to cleanse spaces. In some regions, the tradition of lighting candles or incense at funerals persists, rooted in ancient beliefs. Incense was historically used to communicate with the deceased and is still used in funeral ceremonies today to honor their souls [3]. Archaeologists consider herbs as crucial indicators in archaeological excavations, as they were commonly used for flavoring foods and medicinal purposes in ancient times. As a result, they are frequently discovered in ancient settlements. In Anatolia, harmal seeds were notably cultivated in Gordion, capital of Phrygians, and in Gritille in Southeastern Anatolia, where they were extensively utilized in mound settlements [2]. In pre-Islamic Turkish medicine, various techniques were employed to treat certain ailments. For instance, in the treatment of conditions like demon possession, practices such as applying cold water to a patient's face or using rumen sprinkling and aloe smoking were common. Additionally, there was a prevalent tradition of creating incense to safeguard children from fairies and the evil eye [4].

In the 19th-century medical book Yadigar, pesticide plant "yüzerlik" or "ak hardal" is described. It is suggested that consuming seeds of white mustard up to two spoonfuls daily and sleeping for twenty nights can completely cure the person with the disease. It is noted that this remedy may not be suitable for everyone due to its intoxicating effects, which may cause dizziness. It is advised against consumption by individuals with sensitive temperaments or weak constitutions, and it is recommended to consume it at night rather than during the day [5].

P. harmala L. originates from Asia and is primarily found in regions of the Middle East, South Asia, India, and Pakistan. It is also naturally occurring in Southern Europe, North Africa, Southwest Asia, eastern parts of Tibet, and Türkiye [6,7]. *P. harmala* has served various purposes across different cultures. In India, it was utilized as a dewormer, for narcotic purposes, and antidote against snake bites. Meanwhile, Greeks and Romans employed it for stomach protection, strengthening, and treating diarrhea. In modern medicine, it is valued for its narcotic properties, particularly due to its content of harmine, a central nervous system stimulant [8]. Shamanic tribes, adhering to beliefs of shamanism, burned herbs and inhaled their smoke due to its potential effects on pineal gland in the brain tissue [9]. *P. harmala* typically contains alkaloids ranging from 4% to 7%, including significant compounds such as harmine, harmaline, harmol, and harmalol. Seeds are distinguished by a strong odor and a slightly

bitter taste, and they possess a remarkable ability to be stored for extended periods without spoiling [10]. Harmine, harmaline, harman, and similar alkaloids act as serotonin antagonists. In small doses (25-50 mg), these alkaloids found in *P. harmala* can induce moderate central nervous system stimulation, resulting in effects such as heightened mood, increased energy, improved concentration, and enhanced focus. However, at higher doses (up to 750 mg), hallucinogenic effects of these alkaloids may emerge. These effects include perceptual changes, intensified colors and patterns, and alterations in mental experiences, often leading to hallucinations [11].

Objective of this study is to conduct structural characterization of incense, focusing on fruit and seed components of *P. harmala*, through burning and dissolving its smoke with a suitable solvent. Additionally, we aim to contribute to the literature by investigating presence of hallucinogenic compounds in this incense. Simultaneously, anatomical features of various parts of the *P. harmala*, including pedicels, petals, sepals, stamens, and pistils, were examined through manual sectioning.

MATERIAL AND METHOD

Plant Material

Seeds and some fruits of *P. harmala* were acquired from herbalists in Erzurum. Additionally, in 2018 and 2019, samples of *P. harmala* during its flowering and fruiting stages were collected from Gümüşhane and Iğdır regions by faculty members of Atatürk University Department of Pharmaceutical Botany and Pharmacognosy at Faculty of Pharmacy. These samples were recorded at Atatürk University Biodiversity Application and Research Center with Herbarium number AUEF 1382.

Anatomical Studies

During flowering period, *P. harmala* was collected and preserved in 70% alcohol for subsequent anatomical studies. Sections were manually taken from pedicels, petals, sepals, stamens, and pistils of plant. These sections were examined using sartur and chloral hydrate reagents and photographed at magnifications of 4x, 10x, and 40x using a Zeiss 415500-1800-000 microscope.

Extraction of Volatile Compounds

Seeds and fruits were studied separately using *n*-hexane and dichloromethane as solvents. A novel method, developed by us for the first time, involved burning plant samples and adsorbing resulting incense to solvent using a double-entry balloon and a Clevenger apparatus (Figure 1). Combustion was facilitated using a burner flame. Since the system operated in a closed environment, necessitating temperature control and cooling, ice batteries were utilized to cool walls of balloon. To ensure complete combustion of incense, puffs were released from exit part of the balloon every 1-2 minutes.

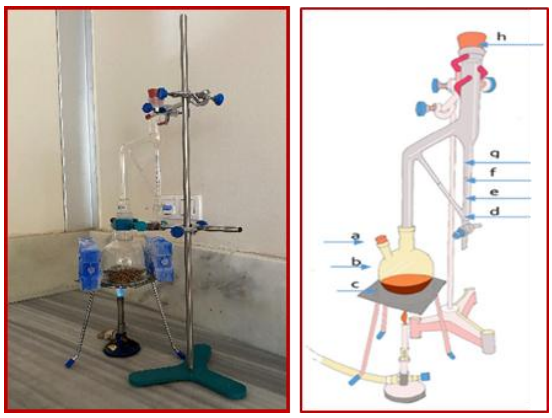

Figure 1. Experimental setup developed by us for first time for adsorption of incense to solvent: a and h: Cork Stopper (with 1-2 minute break for puff process), b: Balloon with two entries, c: Seed or fruit sample, d: Essential oil sinking to bottom, e: *n*-Hexane or dichloromethane solvent, f: Essential oil remaining on top, g: Compounds remaining on walls

After weighing 10 grams of seeds and fruits, they were transferred into a balloon connected to a Clevenger apparatus. Subsequently, 100 ml of *n*-hexane and dichloromethane was introduced into Clevenger apparatus, allowing incense to adsorb into solvent. Samples were then extracted from surfaces of Clevenger apparatus walls and balloon, capturing smoke generated by burning seeds into *n*-hexane and dichloromethane (Figures 2 and 3). These samples were analyzed via GC-MS at Chemical Investigation Branch Directorate of Erzurum Regional Criminal Police Laboratory.

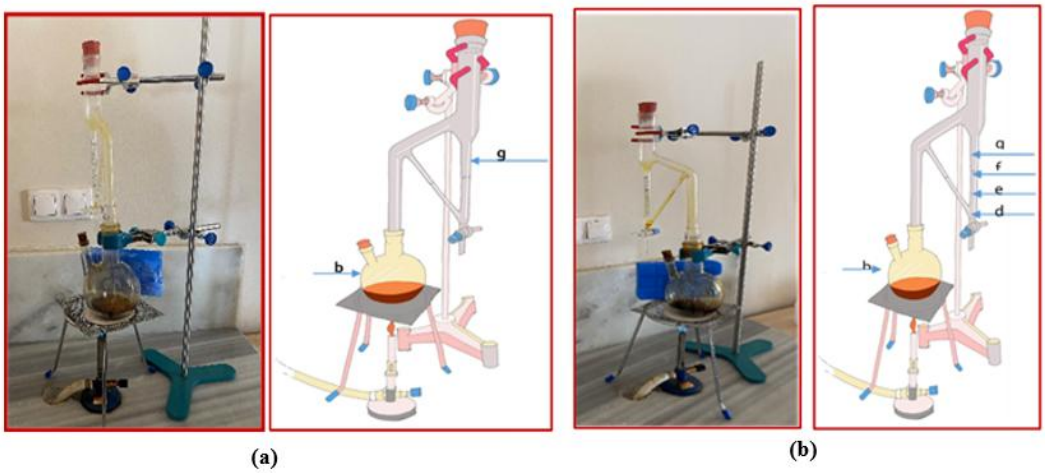

Figure 2. Seeds of *P. harmala* in *n*-hexane solvent (a) and dichloromethane solvent (b)

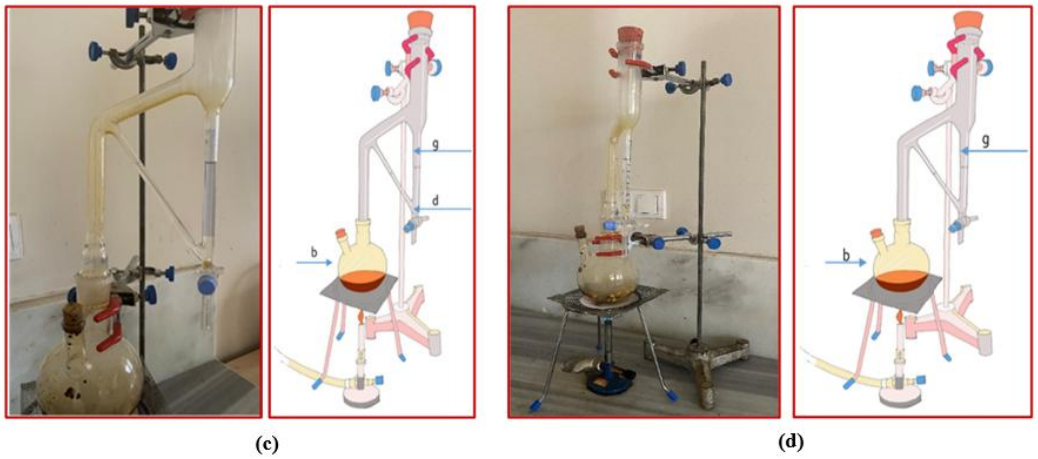

Figure 3. Fruits of *P. harmala* in *n*-hexane solvent (c) and dichloromethane solvent (d)

Gas Chromatography and Mass Spectrometry (GC-MS) Conditions

GC-MS analyses were conducted at Chemical Investigation Branch Directorate of Erzurum Regional Criminal Police Laboratory using an Agilent 5977B GC-MSD device. Commercial libraries such as Cayman, SWGDRUG, and Designer Drugs Library were consulted, alongside computer-assisted matches against MS literature results, to facilitate accurate identification and characterization of compounds. GC-MS analysis conditions are shown as: Column: 30 m length, 0.25 mm inner diameter, 0.25 µm film thickness HP-5, Injection: Splitless, Injector Temperature: 260°C, Carrier Gas: Helium at a flow rate of 1 ml/min, Oven Temperature Program: Initial temperature: 80°C, Initial time: 3 min, Temperature ramp: 10°C/min, Final temperature: 280°C, Final time: 20 min, Interconnection Temperature: 290°C, Mass Spectrometer: Scanning range: 40-400 amu.

RESULT AND DISCUSSION

The primary objective of this study is to identify and analyze the anatomical structures responsible for producing and storing volatile compounds within the plant. Furthermore, the study aims to elucidate the chemical nature and composition of these volatile compounds, providing insights into their potential biological and ecological functions. Sections were manually extracted from various plant parts of *P. harmala*, including the pedicel, petal, sepal, and pistil. In the cross-sectional and superficial anatomy of the pedicel and sepal, multicellular glandular trichomes were prominently observed, suggesting their potential role in secretory functions (Figures 4, 5, and 6). In addition to the glandular structures, druses were identified in the cross-sectional anatomy of the sepal (Figure 5), Furthermore, simple crystals were noted in the superficial anatomy of the petal (Figure 7), contributing to our understanding of the crystalliferous structures within the plant. The stigma of the pistil was characterized as papillary (Figure 8), reflecting its likely role in pollen adhesion and fertilization processes. This detailed anatomical examination highlights the complex structure of *P. harmala* and its potential implications for understanding the plant's physiological functions.

The floral nectary of *P. harmala* was studied using light and electron microscopy. It appeared as a smooth, five-lobed disc around the ovary, consisting of a single-layered epidermis, 15–20 layers of subepidermal secretory cells, and larger parenchymal cells underneath. Phloem tissue, including sieve tubes and companion cells, supported the nectary. Early secretory cells contained starch grains and plastoglobuli, which disappeared as nectar secretion progressed [12]. The root, stem and leaf anatomy of the plant were studied, and it was reported that no secretory character was found [13]. The anatomical structures of *P. harmala* were analyzed. Notable stability features include the presence of ring-shaped sclerenchyma in both stems and roots, along with a bilaterally organized columnar mesophyll in the leaves [14].

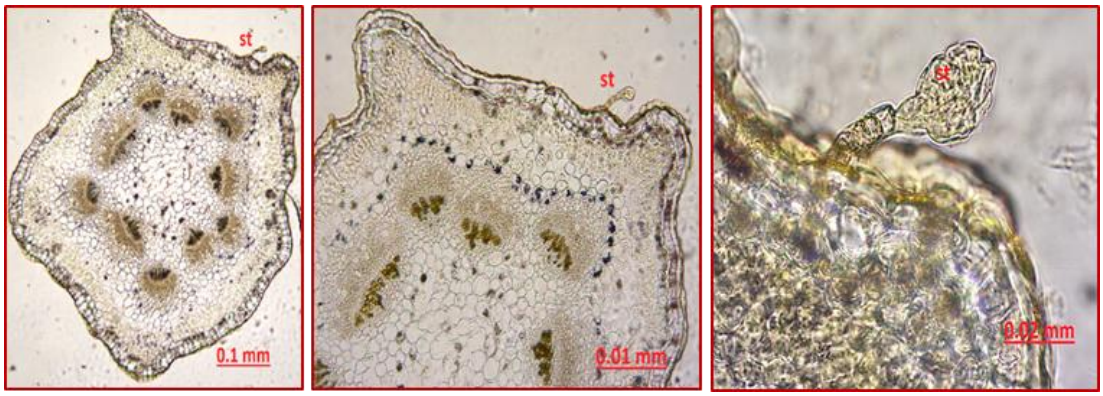

Figure 4. Multicellular glandular trichomes in cross-section of *P. harmala* pedicel. st: glandular trichome

Chemical constituents of seeds and fruits obtained from market-supplied were analyzed using GC-MS. Chromatograms and tables displaying GC-MS findings were generated as a result of analyses. Chemical compositions of volatile compounds from seeds and fruit parts of *P. harmala* were examined. Tables 1-10 were given GC/MS results.

Table 1. GC/MS results of compounds obtained by burning *P. harmala* seeds and taken from balloon walls into dichloromethane

	Compound	Time	%
1	Oleic acid methyl ester	21.8	23.114
2	Harmine	22.8	76.886
	Total		100

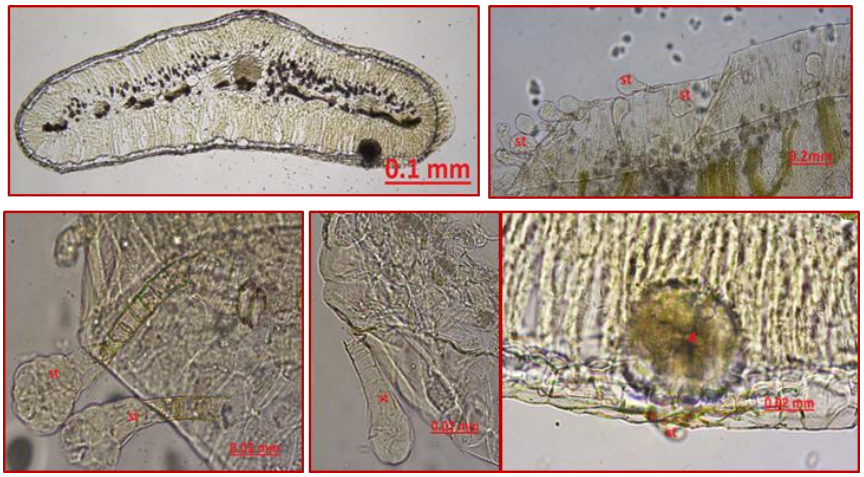

Figure 5. Multicellular glandular trichomes and druse in cross-section of *P. harmala* sepal. st: glandular trichome, d: druse

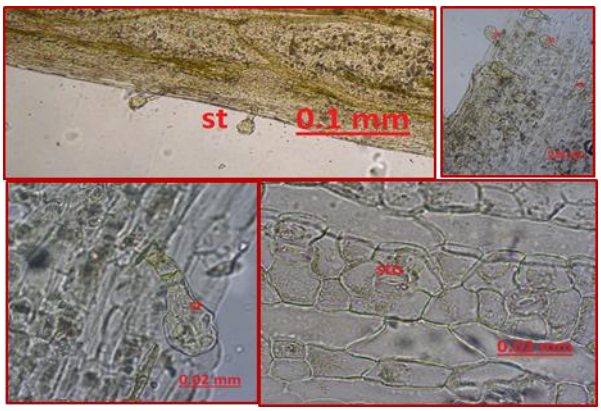

Figure 6. *P. harmala* sepal superficial section anatomy with multicellular glandular trichomes and stomata. st: glandular trichome, sto: stomata

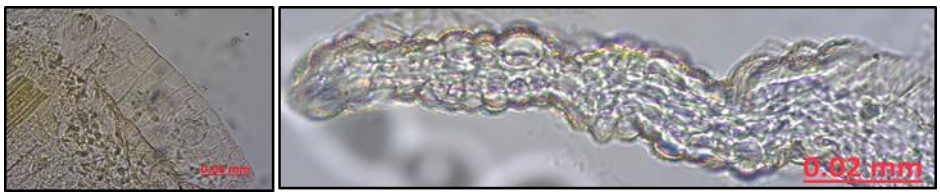

Figure 7. *P. harmala* petal anatomy

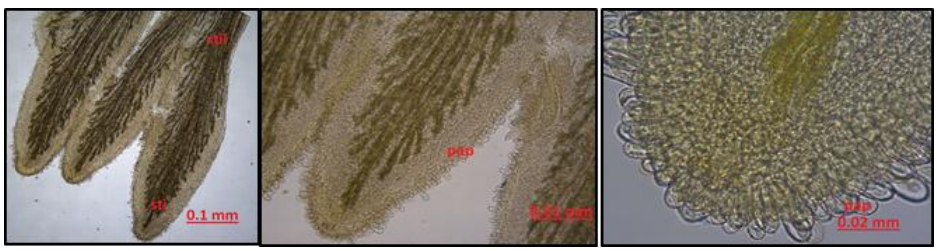

Figure 8. *P. harmala* stigma and style anatomy. sti: stigma, style: stylus, pap: papilla

Table 2. GC/MS results of compounds obtained by burning *P. harmala* seeds and taken into dichloromethane from walls of Clevenger apparatus

	Compound	**Time**	**%**
1	Pyridine	3.3	5.783
2	Heptadec-8-ene	18.9	3.595
3	Palmitic acid methyl ester	20.8	5.992
4	(Z)-9-Octadecene nitrile	21.7	9.491
5	Oleic acid methyl ester	21.8	43.505
6	Harmine	22.8	31.634
	Total		100

Table 3. GC-MS results of compounds obtained by burning *P. harmala* seeds and taken into dichloromethane

	Compound	**Time**	**%**
1	Pyridine	3.3	21.395
2	Pyrrole	3.5	5.356
3	Toluene	3.7	3.290
4	Dimethyl sulfoxide	4.9	16.835
5	2-*methyl-1h*-pyrrole	5.0	2.398
6	2-methoxyphenol	9.7	4.604
7	Pentylbenzene	10.8	3.482
8	Palmitic acid methyl ester	20.8	2.547
9	(Z)-9-Octadecene nitrile	21.7	3.797
10	Oleic acid methyl ester	21.8	19.244
11	Harmine	22.8	17.052
	Total		100

Table 4. GC-MS results of compounds in essential oil sample obtained by burning *P. harmala* seeds and precipitated under Clevenger apparatus

	Compound	**Time**	**%**
1	Pyridine	3.3	20.510
2	Pyrrole	3.5	4.656
3	Toluene	3.7	3.018
4	Methylpyrazine	4.7	2.085
5	2-*methyl-1h*-pyrrole	5.0	1.182
6	*2-Furanmethanol*	5.3	1.853
7	*Aniline*	5.4	0.980
8	*Bicyclo*[*4.2.0*]*octa-1,3,5-triene*	6.1	2.144
9	*1-(2-Furanyl)-ethanone*	6.5	2.168
10	2,3-Di*methyl-1h*-pyrrole	6.7	2.007
11	Propylbenzene	7.3	1.991
12	*Phenol*	7.8	2.362
13	*Decane*	8.1	3.115
14	*n*-Butylbenzene	9.2	2.983
15	p-Cresol	9.4	1.951
16	2-methoxyphenol	9.7	4.010
17	*Undecane*	9.9	2.332
18	Pentylbenzene	10.8	3.782
19	Quinazoline	12.2	1.297
20	*Indole*	12.9	1.864
21	1H.*beta.,8*-di*methyl-(6H.beta.)* *-bicyclo*[*4.4.1*]*undeca-2,4,8- triene*-11-one	18.2	1.453

Table 4 *(continue).* GC-MS results of compounds in essential oil sample obtained by burning *P. harmala* seeds and precipitated under Clevenger apparatus

	Compound	**Time**	**%**
22	(E)-Heptadec-8-ene	18.91	1.882
23	8-Heptadecene	18.96	1.871
24	Palmitic acid methyl ester	20.8	2.077
25	(*Z*)-*9-octadecene nitrile*	21.7	2.939
26	Oleic acid methyl *ester*	21.8	13.916
27	Harmine	22.8	9.571
	Total		100

Table 5. GC-MS results of - essential oil formed on Clevenger apparatus obtained by burning *P. harmala* seeds

	Compound	**Time**	**%**
1	Pyridine	3.3	37.680
2	Pyrrole	3.5	8.563
3	Toluene	3.7	6.649
4	2-*methyl-1h*-pyrrole	5.0	4.826
5	*n*-Butylbenzene	9.2	5.245
6	2-methoxyphenol	9.7	7.426
7	Pentylbenzene	10.8	6.688
8	Indole	12.9	3.838
9	Palmitic acid methyl ester	20.8	2.952
10	Linoleic acid methyl ester	21.7	3.949
11	Oleic acid methyl *ester*	21.8	12.185
	Total		100

Table 6. GC-MS results of compounds obtained by burning *P. harmala* seeds and taken from balloon walls into *n*-hexane

	Compound	**Time**	**%**
1	Linoleic acid methyl ester	21.7	19.729
2	Oleic acid methyl *ester*	21.8	45.801
3	Harmine	22.8	34.470
	Total		100

Table 7. GC-MS results of compounds obtained by burning *P. harmala* seeds and taken into *n*-hexane from walls of Clevenger apparatus

	Compound	**Time**	**%**
1	Diisooctyl adipate	23.49	100
	Total		100

Table 8. GC-MS results of compounds obtained by burning *P. harmala* fruits and taken from walls of flask into dichloromethane

	Compound	**Time**	**%**
1	Harmine	22.8	100
	Total		100

This study investigates compounds with hallucinogenic effects derived from smoke of *P. harmala* seeds and fruits, a plant widely utilized in contemporary herbal incense products known for its relaxing

properties. Simultaneously, anatomical characteristics of pedicels, petals, sepals, stamens, and pistils of plants, commonly found across various regions of Türkiye and extensively utilized by public, were examined. Pedicels, petals, sepals, stamens, and pistils were manually sectioned for examination. It was observed that the volatile compounds of the plant are concentrated within multicellular secretory trichomes located on the pedicels and sepals. These specialized structures play a crucial role in the storage and secretion of volatile compounds, indicating their significance in the plant's chemical ecology and potential aromatic properties. Seeds and fruits were procured from local markets and herbalists in Erzurum. To facilitate extraction of incense, a custom-built mechanism was devised, employing a double-entry balloon and Clevenger apparatus. This apparatus enabled burning of plant and absorption of resulting smoke into solvents, namely *n*-hexane and dichloromethane. Presence of harmine in samples extracted using dichloromethane and n-hexane were determined.

Table 9. GC-MS results of compounds obtained by burning *P. harmala* fruits and taken into *n*-hexane from walls of Clevenger apparatus

	Compound	**Time**	**%**
1	Pyridine	3.38	100
	Total		100

Table 10. GC-MS results of compounds extracted into *n*-hexane from essential oil obtained by burning *P. harmala* fruits and precipitated under Clevenger apparatus

	Compound	**Time**	**%**
1	Pyridine	3.3	15.069
2	*2,4*-Pentadienenitrile	3.5	1.436
3	Pyrrole	3.6	0.927
4	*Furan-2*-carboxaldehyde	4.9	3.230
5	*Butyrolactone*	6.6	0.923
6	*4*-Hydroxy-*N*-methylpiperidine	7.9	0.594
7	*3*-Methyl-*1,2*-cyclopentanedione	8.7	0.764
8	*3-pyridinol*	10.0	3.955
9	*2-Methyl-4-oxo-pentanoic acid methyl ester*	10.6	0.852
10	Catechol	11.5	1.559
11	*1,4:3,6-Dianhydro*-alpha-*d*-glucopyranose	11.6	0.741
12	Quinazoline	12.2	0.853
13	Oxalic acid, monomorpholide, nonyl *ester*	13.5	1.058
14	*4-Methylproline methyl ester*	14.1	1.422
15	Deoxypeganine	20.1	2.686
16	Octahydrodipyrrolo[*1,2*-a: 1',2'-d]pyrazine-*5,10*-dione, (5aR,10aR) (isomer 2)	21.0	0.920
17	*2,3-Dihydro-1H*-pyrrolo[*2,1-b*]quinazolin-*9*-one	21.1	0.734
18	Harmine	22.9	61.852
19	9H-Pyrido[3,4-b]indole, 7-methoxy-1,9-dimethyl	23.1	0.423
	Total		100

A total of 12 different samples obtained from *P. harmala* were subjected to analysis. Following are results of analysis conducted on GC-MS device, focusing on smoke produced by burning seeds and extracted using dichloromethane and *n*-hexane as solvents.

1. As a result of GC-MS analysis of samples taken with *n*-hexane as solvent; harmine compound was detected in samples taken from balloon walls.

2. As a result of GC-MS analysis of samples taken with dichloromethane as a solvent; harmine

compound was detected in sample taken from balloon walls into dichloromethane, in sample taken from walls of Clavenger apparatus into dichloramethane, in essential oil sample settled under Clavenger apparatus, and in essential oil sample formed above Clavenger apparatus.

3. As a result of analysis of samples taken with *n*-hexane as a solvent by GC-MS; harmine compound was detected in fly oil sample that settled under Clavenger apparatus.

4. As a result of GC-MS analysis of samples taken with dichloromethane as a solvent; harmine compound was detected in sample taken from balloon walls.

Results of analysis of smoke obtained by burning fruits and using dichloromethane and *n*-hexane as solvents on GC-MS device are listed below.

I. As a result of GC-MS analysis of samples taken with *n*-hexane as solvent; harmine compound was detected in fly oil sample that settled under Clavenger apparatus.

II. As a result of GC-MS analysis of samples taken with dichloromethane as a solvent; harmine compound was detected in sample taken from balloon walls.

Studies examining chemical components of extracts indicate that *β*-carboline and quinazoline alkaloids are significant components of plant. Herraiz et al. (2010) investigated thatconcentration of harmaline in various parts of plant, including seeds, fruits, and capsule walls, was determined using RP-HPLC to be 56.0 mg/g, 4.55 mg/g, and 0.54 mg/g, respectively. *β*-carboline alkaloids, including harmaline, harmine, harmalol, harmol, and tetrahydroharmine, were identified and quantified as main constituents in *P. harmala* extracts. Alkaloid levels were highest in seeds and roots, with negligible amounts in stems and leaves, and absence in flowers. Dry seeds contained harmine (4.3%), harmaline (5.6%), harmalol (0.6%), and tetrahydroharmine (0.1%), while roots contained harmine (2.0%) and harmol (1.4%) [11]. While harmaline and harmine are typically primary alkaloids responsible for plant's beneficial effects, numerous studies suggest that other alkaloids found in *P. harmala* also contribute to its pharmacological effects [15]. Harmaline, constitutes major alkaloid, was initially isolated by Friedemann Gebel in 1837 from seeds and roots of *P. harmala*. Harmaline and harmine, along with harmalol and harman, are *β*-carboline derivatives primarily concentrated in seeds and roots of plant. Tetrahydroharmine, another *β*-carboline derivative, is predominantly found in seeds, while harmol is sourced from seeds as well. l-thioformyl-8-*β*-D-glucopyranoside-bis2,3-dihydroisopyridinopyrrol is a quinazoline derivative primarily found in the aerial parts. Deoxypeganine, deoxyvasicinone, vasicine (peganine), vasicinone, isopeganine, pegamine, peganol, peganones, and vascinones, all quinazoline derivatives, are distributed throughout various parts of whole plant. Additionally, dipegene, another quinazoline derivative, is specifically located in seeds [16]. A study was conducted to evaluate the composition of two smoke condensates obtained from the seeds of *P. harmala*, which is traditionally recognized as a disinfectant agent in Iran. This investigation aims to elucidate the chemical profile of these smoke condensates and their potential applications in disinfection. Composition of smoke preparations was analyzed using GC-MS. Primary compound identified in dichloromethane extract was harmine as in our study [17]. Chemical analysis of *P. harmala* chloroform extract revealed three alkaloids in ripe fruit and two in flower and leaves, with harmine, peganine, and harmaline found in ripe fruit and harmine and peganine in flower. Harmaline was exclusively detected in ripe fruit. Total alkaloid content comparison by TLC showed 3.12% and 3.27% in flower and ripe fruit, respectively [18]. *P. harmala* smoke has traditionally been employed as a disinfectant and air purifier in various Middle Eastern and Asian countries. The smoke collection process involved capturing the emissions from smoldering 100 grams of plant material using a specially designed apparatus, which maintained a temperature of 300 ± 10°C with non-continuous airflow. The resulting smoke, characterized by its acidic pH, was then trapped in a mixture of distilled water and *n*-hexane and continuously agitated. The primary objective of this study was to develop a reproducible method for generating and collecting smoke in order to analyze the chemical composition of *P. harmala* smoke and compare it to other compositions. Given its historical use in traditional medicine and the potential for generating antimicrobial and immunomodulatory compounds, further research may reveal components that could act as preventive agents against airborne infections. Furthermore, conducting toxicological studies is essential. Broadening the research focus on the medicinal properties of *P. harmala* smoke could play a crucial role in the standardization of medicinal smokes as a viable dosage form in traditional medicine and ethnopharmacology [19]. However, in this study, no substance related to alkaloid content we discovered

was identified.

Harmine is a psychoactive compound traditionally used in shamanic rituals that exerts significant effects on the central nervous system, including hallucinogenic properties. This compound can profoundly alter individuals' perceptions, thoughts, and emotions. Its psychoactive effects have garnered considerable interest in both medicinal and research contexts. As a monoamine oxidase inhibitor, harmine influences neurotransmitter transmission among nerve cells, particularly affecting serotonin, dopamine, and norepinephrine levels. This modulation can lead to various hallucinogenic experiences, which may include profound mental alterations, visual and perceptual distortions, and vivid, colorful hallucinations. Users often report emotional fluctuations and a sense of expanded consciousness. Given these diverse effects, harmine and similar compounds hold promise for further exploration in both therapeutic and experiential realms. However, use and effects of harmine may vary from person to person and may be different for each individual. Harmine can also be found in some traditional herbal mixtures used in ethnic and religious rituals. However, legal status of harmine varies between countries and local laws. It is important to comply with legal regulations regarding the use of such substances. The habit of burning incense can turn into an addiction for some people after a while. Aroma and active ingredients in incense can create relaxing and calming effects on brain, causing people to develop a desire to burn incense. Incense addiction is generally considered a mild addiction and does not pose a serious problem for most people. Therefore, it is important that the use of incense is limited and done carefully. When we look at journey of *P. harmala* from past to present, we see that it has a place in many areas from folk culture to scientific research. New usage areas emerge every day. We believe that many studies will be conducted with *P. harmala* in the future. [20-23].

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CONFLICT OF INTEREST

The authors declare that there is no real, potential, or perceived conflict of interest for this article.

ETHICS COMMITTEE APPROVAL

The authors declare that the ethics committee approval is not required for this study.

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